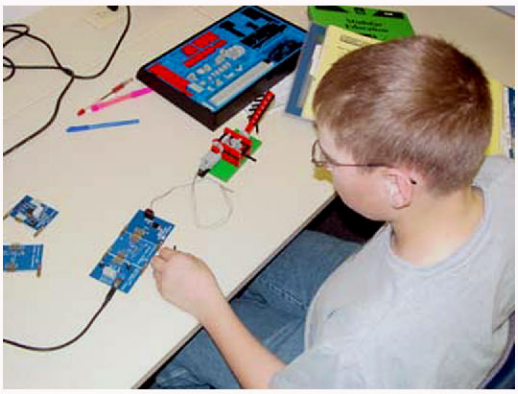
Technology Education



A North Dakota Curricular Framework

Technology Education

North Dakota has been a charter member of the Center to Advance the Teaching of Technology and Science (CATTS) consortium since 1998. North Dakota has adopted the model course guides as the state curricular framework. In addition, to support the model course guides published by the CATTS consortium, the STL standards have also been adopted as the state standards for technology education.

A North Dakota Curricular Framework

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Introduction to Technology

The origins of technology education

Technology teaching has evolved as technology has advanced. During the industrial era of the 20th century, it was taught in the schools as industrial arts, reflecting the industrial society. As advancements have catapulted us into a faster moving, more highly sophisticated, technological society, technology education has made content adjustments that reflect these changes. Generally, the public is unaware of these changes in curriculum and content.

The purpose of technology education

In a word, it is about INNOVATION! It is about how people think! It is how to apply technology in the solution of problems facing society! The aim is to solve problems and create opportunities within a realistic context. That context can start with the student's everyday environment and progressively move into more global issues.

Examples of technology problems and learning situations could be the cleaning of a stream that has become polluted, the creating and fabricating of an invention to solve a household problem, or the designing and building of a habitat for a unique situation. The thinking process is closely related to that of an engineer, hi-tech worker, designer, or an architect.

Students use their ingenuity with tools, materials, processes and resources to create solutions and opportunities for themselves and others. The nature of learning goes from the very early years of just "knowing" to more developed applications that relate to the medical, agricultural, energy and power, information and communication, transportation, manufacturing and construction technologies. It is a new and dynamic subject in our schools that is as fast moving and as up-to-date as the thinking of technology in our society! It is future workforce thinking!

Students will be equipped with foundational skills, knowledge and confidence to create new and better products, enhanced forms of communication and entertainment and provide us with more efficient means for mobility in our ever shrinking world and outer space.

William E. Dugger, DTE

Changing Emphasis in Technology Education

Less Emphasis On:	*More Emphasis On:*
❑ Knowing technical details and parts of tools	❑ Understanding systems and their interrelated parts
❑ Activities that are fun	❑ Selecting fun activities that reinforce and teach content
❑ Processes and skills to complete a project	❑ Designing and planning before making
❑ Working alone	❑ Working in groups or teams
❑ Teacher as information expert	❑ Teacher as facilitator of student learning
❑ Management of materials and equipment	❑ Management of ideas and information
❑ Student communicates to teacher	❑ Student presents information to classes
❑ Tests as the only assessment	❑ Self and team evaluation and reflection
❑ Right or wrong solution	❑ Open-ended, innovative, creative solutions that allow for opportunities to take risks and discover what works

Technology Education is Innovation in Action!

The importance of teaching technology to our students

A central role of an educational institution is to offer a curriculum that gives its students a basic understanding of the society in which they live. While our society is certainly both democratic and technological, not enough emphasis is placed on the technology component through school curriculums. People are losing touch with a fundamental aspect of society due to the fact that educational institutions impart so little understanding of our technological base.

Technological systems include input, processes, output and feedback.

We risk underestimating the importance of the assessment of technological change or assuming that the assessment of technological change is entirely a scientific process. With our current zeal to improve schools, now is the time to examine how technology should be taught.

The positive effects that teaching technology has on our workforce and society

A major consequence of accelerating technological change is a difference in levels of technological ability and understanding. The workforce of the future must have the ability to use, manage and understand technology. Indeed, technological literacy is vital to individual, community and national economic prosperity. Beyond economic vitality is the realization that how people develop and apply technology has become critical to future generations, society and even the Earth's continued ability to sustain life.

Technology facilities

Classroom-laboratories can be found in most secondary public schools. These facilities usually have a research and design area used in the planning stages of invention, innovation and construction. Facilities have a fabrication space where students can construct, build or complete manipulative activities that relate to their work. Selected facilities have testing and experimentation areas. It is not uncommon for technology laboratories to have "clean rooms," as well as fabrication areas. Such facilities are mistaken for technical education areas due to the equipment often used in activities. Finally, many facilities have specific learning stations that allow individual studies on technical topics such as rocketry, telecommunications, computer numerical control, and more. Facilities vary depending upon the content emphasis of each program.

Technologically literate students

An NSF/NASA-funded standards project was used to identify what students should know and be able to do to become technologically literate. The publication, “Standards for Technological Literacy: Content for the Study of Technology,” was created and passed a formal review by the National Academy of Engineering, the National Research Council and the technology teaching community.

The standards identify content related to the nature of technology, technology and society, design, abilities for a technological world and the designed world. Knowledge has been identified for grade levels K-2, 3-5, 6-8 and 9-12. Content is integrated into thematic units at the elementary levels, while course titles at the middle and high school levels may

Technology is concerned with applying knowledge to create an easier and better lifestyle for humankind.

J.M. Ritz
W.S. Swail

include Exploring Technology, Innovation and Engineering Design, Technological Systems, Engineering Design Fundamentals and more. The standards also address medical, agricultural and related biotechnologies, energy and power, information and communication, transportation, manufacturing and construction topics.

Challenge pertaining to technology teaching

The challenge is not whether technology should be offered or how it should be taught. The real challenge is how it will be possible for a country to maintain a competitive technological advantage if it continues to ignore teaching about technology and innovation. To maintain its superiority as a technological leader, a country must teach and emphasize the study of technology beyond its use as a delivery system for other subjects.

Technology plays an increasingly important role in our society and affects our everyday existence. Our ability to understand, use and manage it in our daily lives requires that it become a significantly supported educational initiative rather than one ignored by legislation. Fortunately, the groundwork has been completed with help from our nation's most prestigious science and technology agencies. The important step in progress is the realization that our technological superiority and affluence as a nation will not continue unless our populace is educated to take advantage of the opportunities that now exist.

Technology integration in our schools

Elementary teachers teach about technology through integrated activities that are a part of their daily school curriculum. One example would be a design/engineering activity to plan and build a community. Such an activity would integrate the subjects of technology, social studies, math, science, and language arts with the opportunity to create a hands-on community planning experience. The culminating experience is the building of a student-planned city with consideration for transportation, communication, environmental and construction systems.

There are an estimated 35,000 U.S. public school secondary technology teachers with each state having its own customized technology program.

The purpose of Technology Education is to provide the knowledge, competencies, skills, and opportunities for students to succeed in a technological society.

Technology is an elective in most locations with a few states such as New York and Maryland having requirements for high school graduation. Technology teaching does not benefit from the same educational funding, support or time in the school schedule as the other core subjects. Technology programs are only funded in a limited number of Eisenhower Programs.

Technology is often a required course at the middle school with courses such as Exploring Technology, Introduction to Technology and Inventions/Innovations. More detailed courses are offered as electives at the high school level with titles such as Manufacturing or Communication. With the release of the "Standards for Technological Literacy: Content for the Study of Technology," courses such as Technological Systems, Innovation and Engineering Design and Technology Assessment will be available as course offerings.

We live in a technology world, rapidly growing complex and more sophisticated. Each of us needs to know more about technology in order to participate in its development, use and control.

J.R. Johnson

Technology Literacy Standards

Students will develop an understanding of The Nature of Technology

This includes acquiring knowledge of:

1. The characteristics and scope of technology
2. The core concepts of technology
3. The relationships among technologies and the connections between technology and other fields

Students will develop an understanding of Technology and Society

This includes learning about:

4. The cultural, social, economic and political effects of technology
5. The effects of technology on the environment
6. The role of society in the development and use of technology
7. The influence of technology on history

Students will develop an understanding of Design

This includes knowing about:

8. Attributes of design
9. Engineering design
10. The role of troubleshooting, research and development, invention and innovation and experimentation in problem solving

Students will develop Abilities for a Technological World

This includes becoming able to:

11. Apply the design process
12. Use and maintain technological products and systems
13. Assess the impact of products and systems

Students will develop an understanding of The Designed World

This includes selecting and using:

14. Medical technologies
15. Agricultural and related biotechnologies
16. Energy and power technologies
17. Information and communication technologies
18. Transportation technologies
19. Manufacturing technologies
20. Construction technologies

Technology Education Program Levels

Elementary Focus

The curriculum for elementary education draws upon the reality of technology in the world to stimulate the learner's curiosity through exploration in a variety of hands-on experiences.

Technology education content can be integrated with current curriculum. Elementary teachers may integrate technology content in a thematic unit or develop a technology strand in a social studies or language arts activity.

Primary students may design and build habitats to address the needs of a nomadic peoples or create signs that direct people to various parts of a building. At the intermediate level, students may design and develop an

Technology Education provides students an excellent opportunity to acquire career information, develop insights and understanding of Technology and impact on society, and provides the opportunity to explore and develop leisure time interests.

efficient transportation system for a given rural or urban site as part of a social studies unit.

Students should experience technology by engaging in activities involving design, problem-solving, creating solutions through trial and error, as well as controlled testing.

Students will learn that technology involves problem solving, research and development, invention, innovation and experimentation relevant to the world around them.

Benchmarks for Grades K-2

(Adopted from Executive Summary Compendium of Major Topics for Technology Content Standards. Refer to Standards For Technological Literacy, Copyright 2000, International Technology Education Association for complete listing.)

1. The Characteristics and Scope of Technology
   - ◆Natural world and human-made world
   - ◆People and technology
2. The Core Concepts of Technology
   - ◆Systems
   - ◆Resources
   - ◆Processes
3. The Relationships Among Technologies and the Connections Between Technology and Other Fields
   - ◆Connections between technology and other subjects
4. The Cultural, Social, Economic and Political Effects of Technology
   - ◆Helpful or harmful
5. The Effects of Technology on the Environment
   - ◆Reuse and/or recycling of materials
6. The Role of Society in the Development and Use of Technology
   - ◆Needs and wants of individuals
7. The Influence of Technology on History
   - ◆Ways people have lived and worked
8. The Attributes of Design
   - ◆Everyone can design
   - ◆Design is a creative process
9. Engineering Design
   - ◆Engineering design process
   - ◆Expressing design ideas to others
10. The Role of Troubleshooting, Research and Development, Invention and Innovation and Experimentation in Problem Solving
    - ◆Asking questions and making observations
    - ◆All products need to be maintained

Technology Education is an educational program that helps people develop an understanding and competence in designing, producing and using technology products and systems, and in assessing the appropriateness of technological actions.

ITEA

11. Apply the Design Process
    - ◆Solve problems through design
    - ◆Investigate how things are made
    - ◆Build something

12. Use and Maintain Technological Products and Systems
    - ◆Discover how things work
    - ◆Use tools correctly and safety
    - ◆Recognize and use every day symbols

13. Assess the Impact of Products and Systems
    - ◆Collect information about everyday products
    - ◆Determine the qualities of a product

14. Medical Technologies
    - ◆Vaccinations
    - ◆Medicine
    - ◆Products to take care of people and their belongings

15. Agricultural and Related Biotechnologies
    - ◆Technologies in agriculture
    - ◆Tools and materials for use in ecosystems

16. Energy and Power Technologies
    - ◆Energy comes in many forms
    - ◆Energy should not be wasted

17. Information and Communications Technologies
    - ◆Information
    - ◆Communication
    - ◆Symbols

18. Transportation Technologies
    - ◆Transportation system
    - ◆Individuals and goods
    - ◆Care of transportation products and systems

19. Manufacturing Technologies
    - ◆Manufacturing systems
    - ◆Design of products

20. Construction Technologies
    - ◆Different types of buildings
    - ◆How parts of buildings fit

Technology is the modification of the natural environment in order to satisfy perceived human needs.

Benchmarks for Grades 3-5

(Adopted from Executive Summary Compendium of Major Topics for Technology Content Standards. Refer to Standards For Technological Literacy, Copyright 2000, International Technology Education Association for complete listing.)

1. The Characteristics and Scope of Technology
    - ◆Tools, materials and skills
    - ◆Creative thinking
    - ◆Things found in nature and in the human-made world

2. The Core Concepts of Technology
    - ◆Systems
    - ◆Requirements
    - ◆Resources
    - ◆Processes

Technological literacy is the ability to use, manage, assess and understand technology.

3. The Relationships Among Technologies and the Connections Between Technology and Other Fields
   - ◆Technologies integrated
   - ◆Relationships between technology and other fields of study
4. The Cultural, Social, Economic and Political Effects of Technology
   - ◆Good and bad effects
   - ◆Unintended consequences
5. The Effects of Technology on the Environment
   - ◆Recycling and disposal of waste
   - ◆Affects environment in good and bad ways
6. The Role of Society in the Development and Use of Technology
   - ◆Changing needs and wants
   - ◆Expansion or limitation of development
7. The Influence of Technology on History
   - ◆Tools for food, clothing and protection
8. The Attributes of Design
   - ◆Definitions of design
   - ◆Requirements of design
9. Engineering Design
   - ◆Engineering design process
   - ◆Models
   - ◆Creativity and considering all ideas
10. The Role of Troubleshooting, Research and Development, Invention and Innovation and Experimentation in Problem Solving
    - ◆Troubleshooting
    - ◆Invention and innovation
    - ◆Experimentation

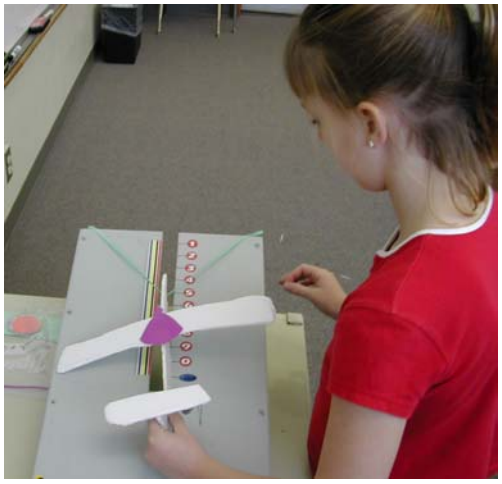
11. Apply the Design Process
    - ◆Collecting information
    - ◆Visualize a solution
    - ◆Test and evaluate solutions
    - ◆Improve a design
12. Using and Maintain Technological Products and Systems
    - ◆Follow step-by-step instructions
    - ◆Use computers to access and organize information
    - ◆Use common symbols
    - ◆Select and safely use tools
13. Assess the Impact of Products and Systems
    - ◆Use information to identify patterns
    - ◆Examine trade-offs
    - ◆Assess the influence of technology
14. Medical Technologies
    - ◆Vaccines and medicine
    - ◆Use of products and systems to inform
    - ◆Development of devices to repair or replace certain parts of the body
15. Agricultural and Related Biotechnologies
    - ◆Artificial ecosystems
    - ◆Agriculture wastes
    - ◆Processes in agriculture

Engineering design is influenced by personal characteristics, such as creativity, resourcefulness and the ability to visualize and think abstractly.

Systems, which are the building blocks of technology, are embedded within larger technological, social and environmental systems.

16. Energy and Power Technologies
    - ◆Energy comes in different forms
    - ◆Tools, machines, products and systems use energy to do work

17. Information and Communications Technologies
    - ◆Processing information
    - ◆Communication
    - ◆Many sources of information
    - ◆Symbols



18. Transportation Technologies
    - ◆Transportation systems use
    - ◆Transportation systems and subsystems

19. Manufacturing Technologies
    - ◆Natural materials
    - ◆Manufacturing processes
    - ◆Consumption of goods
    - ◆Chemical technologies

20. Construction Technologies
    - ◆Modern communities
    - ◆Structures
    - ◆Systems used

Inventions and innovations are the results of specific, goal-directed research.

Middle School Course Descriptions

Exploring Technology

Students explore the scope of technology and its innovations. Technology topics in authentic situations guide students to learn about technology and experience how it is designed to help us.

This course may be 6 –18 weeks in duration.

A read only version of Exploring Technology may be viewed at:
http://www.state.nd.us/cte/secondary/programs/tech-ed/curriculum.html

Innovations and Engineering Design

Everything people make and use begins as an idea. Students are acquainted with the process of engineering design and how it leads to innovations. Students get first-hand experience in brainstorming, visualizing, modeling, constructing and testing design ideas. Presenting engineered designs using effective presentation skills is emphasized.

This course is suited for 18 weeks.

A read only version of Innovations and Engineering Design may be viewed at:
http://www.state.nd.us/cte/secondary/programs/tech-ed/curriculum.html

(to be developed 2002-03)

Economic, political and cultural issues are influenced by the development and use of technology.

Technological Systems

Students explore technological systems; their design, development and connections with other systems. They create, test and evaluate systems, such as transportation, information and biotechnology systems. Students learn technology that is made up of many systems that have positive and negative effects on society.

This course may be 18 weeks or 36 weeks in duration.

A read only version of Technological Systems may be viewed at:
http://www.state.nd.us/cte/secondary/programs/tech-ed/curriculum.html
(to be developed 2003-04)

The use of technology affects humans in various ways, including their safety, comfort, choices and attitudes about technology's development and use.

Benchmarks for Middle School

(Adopted from Executive Summary Compendium of Major Topics for Technology Content Standards. Refer to Standards For Technological Literacy, Copyright 2000, International Technology Education Association for complete listing.)

1. The Characteristics and Scope of Technology
   - ◆Usefulness of technology
   - ◆Development of technology
   - ◆Human creativity and motivation
   - ◆Product demand

2. The Core Concepts of Technology
   - ◆Systems
   - ◆Resources
   - ◆Requirements
   - ◆Trade-offs
   - ◆Processes
   - ◆Controls

3. The Relationships Among Technologies and the Connections Between Technology and Other Fields
   - ◆Interaction of systems
   - ◆Interrelation of technological environments
   - ◆Knowledge from other fields of study and technology

4. The Cultural, Social, Economic and Political Effects of Technology
   - ◆Impacts and consequences
   - ◆Attitudes toward development and use
   - ◆Ethical Issues
   - ◆Influences on economy, politics and culture

5. The Effects of Technology on the Environment
   - ◆Management of waste
   - ◆Technologies repair damage
   - ◆Environmental vs. economic concerns

Technology, by itself, is neither good nor bad, but decisions about the use of products and systems can result in desirable or undesirable consequences.

6. The Role of Society in the Development and Use of Technology
   - Inventions and innovations
   - Social and cultural priorities
   - Acceptance and use of products and systems
   - Development driven by demands, values and interests

7. The Influence of Technology on History
   - Processes of inventions and innovations
   - Evolution of techniques, measurements and resources
   - Technological and scientific knowledge
   - Specialization of labor

Technological process promotes the advancement of science and mathematics.

8. The Attributes of Design
   - Design leads to useful products and systems
   - There is no perfect design
   - Requirements

9. Engineering Design
   - Iteration
   - Brainstorming
   - Modeling, testing, evaluating and modifying

10. The Role of Troubleshooting, Research and Development, Invention and Innovation and Experimentation in Problem Solving
    - Troubleshooting
    - Invention and innovation
    - Experimentation

Technology transfer occurs when a new user applies an existing innovation developed for one purpose in a different function.

11. Apply the Design Process
    - Apply design process
    - Model a solution to a problem
    - Make a product or system
    - Identify criteria and constraints
    - Test and evaluate

12. Use and Maintain Technological Products and Systems
    - Operate Systems
    - Use information to see how things work
    - Use computers and calculators
    - Safely use tools to diagnose, adjust and repair

13. Assess the Impact of Products and Systems
    - Identify trends
    - Design and use instruments to find trends
    - Use collected data to find trends
    - Interpret and evaluate accuracy of information

14. Medical Technologies
    - Sanitation processes
    - Awareness about genetic engineering
    - Immunology
    - Advances and innovations in medical technologies

15. Agricultural and Related Biotechnologies
    - Technological advances in agriculture
    - Specialized equipment and practices
    - Biotechnology and agriculture
    - Artificial ecosystems and management
    - Development of refrigeration, freezing, dehydration, preservation and irradiation
16. Energy and Power Technologies
    - Energy is the capacity to do work
    - Energy can be used to do work using many processes
    - Efficiency and conservation
    - Power systems
    - Power is the rate at which energy is converted from one form to another
17. Information and Communication Technologies
    - Information and communication systems
    - Factors influencing the design of a message
    - Language of technology
    - Communication systems encode, transmit and receive information

18. Transportation Technologies
    - Subsystems of transportation system
    - Design and operation of transportation
    - Transportation processes systems
    - Governmental regulations
19. Manufacturing Technologies
    - Manufacturing systems
    - Manufacturing goods
    - Manufacturing processes
    - Chemical technologies
    - Material use
    - Marketing products
20. Construction Technologies
    - Construction designs
    - Foundations
    - Purpose of structures
    - Buildings systems and sub-systems

Knowledge gained from other fields of study has a direct effect on the development of technological products and systems.

The development of technology is a human activity and is the result of individual or collective needs and the ability to be creative.

High School Course Descriptions

Foundations of Technology

Technology consists of key concepts and processes. Students learn that technology is the basis for all that we have and do. Students design and develop innovations and engineer solutions to gain an understanding of technology. Mathematics and science concepts are studied as they contribute to the unit topics.

This course may be either 18 weeks or 36 weeks in duration.

A read only version of Foundations of Technology may be viewed at:
http://www.state.nd.us/cte/secondary/programs/tech-ed/curriculum.html

Technology Assessment

Students learn that no technology is perfect and that there are systematic ways to assess technology. Students practice approaches to assess technology using analytical thinking, decision-making and techniques for redesigning.

This course may be either 18 weeks or 36 weeks in duration.

A read only version of Technology Assessment may be viewed at:
http://www.state.nd.us/cte/secondary/programs/tech-ed/curriculum.html
(to be developed 2003-2004)

Innovations in Technology

Technology is designed to meet particular needs and wants at a given time. Students develop abilities to design, use, maintain and assess the following technologies: Medical, agricultural and biotechnologies, energy and power, information and communication, transportation, manufacturing and construction. Simulations, prototyping, case studies and group seminars engage students in developing solutions that lead to innovations.

This course may be either 18 weeks or 36 weeks in duration.

A read only version of Innovations in Technology may be viewed at:
http://www.state.nd.us/cte/secondary/programs/tech-ed/curriculum.html
(to be developed 2004-05)

Design for Engineering

Students develop an understanding of what engineers study and practice. Students apply technology, science and mathematics to solve engineering problems. Design effectiveness, public safety, human factors and ethics are addressed in authentic situations.

This course may be either 18 weeks or 36 weeks in duration.

A read only version of Design for Engineering may be viewed at:
http://www.state.nd.us/cte/secondary/programs/tech-ed/curriculum.html
(to be developed 2002-03)

Because of the power of today's technological processes, society and individuals need to decide what, how and when to develop or use various technological systems.

Benchmarks for High School

(Adopted from Executive Summary Compendium of Major Topics for Technology Content Standards. Refer to Standards For Technological Literacy, Copyright 2000, International Technology Education Association for complete listing.)

1. The Characteristics and Scope of Technology
   - ◆Nature of technology
   - ◆Goal-directed research
   - ◆Rate of technological diffusion
   - ◆Commercialization of technology
2. The Core Concepts of Technology
   - ◆Systems
   - ◆Requirements
   - ◆Processes
   - ◆Resources
   - ◆Optimization and Trade-offs
   - ◆Controls
3. The Relationships Among Technologies and the Connections Between Technology and Other Fields

   - ◆Technology transfer
   - ◆Innovation and invention
   - ◆Knowledge protection and patents
   - ◆Technological knowledge and advances of science and mathematics and vice versa
4. The Cultural, Social, Economic and Political Effects of Technology
   - ◆Rapid or gradual changes
   - ◆Trade-offs and effects
   - ◆Ethical implications
   - ◆Cultural, social, economic and political changes
5. The Effects of Technology on the Environment
   - ◆Reduce resource use
   - ◆Monitor environment
   - ◆Decisions and trade-offs
   - ◆Reduce negative consequences of technology
   - ◆Conservation
   - ◆Alignment of natural and technological processes
6. The Role of Society in the Development and Use of Technology
   - ◆Different cultures and technologies
   - ◆Development decisions
   - ◆Factors affecting designs and demands of technologies
7. The Influence of Technology on History
   - ◆Evolutionary development of technology
   - ◆The Iron Age
   - ◆The Renaissance
   - ◆The Information Age
   - ◆Dramatic changes in society
   - ◆Early technological history
   - ◆The Middle Ages
   - ◆The Industrial Revolution
   - ◆History of technology
8. The Attributes of Design
   - ◆The design process
   - ◆Design problems are usually not clear
   - ◆Designs need to be refined
   - ◆Requirements

Some systems are found in nature, and some are made by humans.

Technology Education is the use of ingenuity with tools, materials, processes and resources.

9. Engineering Design
   - ◆Design principles
   - ◆Influence of personal characteristics
   - ◆Prototypes
   - ◆Factors in engineering design

10. The Role of Troubleshooting, Research and Development, Invention and Innovation and Experimentation in Problem Solving
   - ◆Research and development
   - ◆Researching technological problems
   - ◆Multidisciplinary approach
   - ◆Not all problems are technological or can be solved

11. Apply the Design Process
   - ◆Identify a design problem
   - ◆Identify criteria and constraints
   - ◆Refine the design
   - ◆Evaluate the design
   - ◆Reevaluate final solution(s)
   - ◆Develop a product or system using quality control

12. Using and Maintain Technological Products and Systems
   - ◆Diagnose a malfunctioning system
   - ◆Document and communicate processes and procedures
   - ◆Use computers to communicate
   - ◆Troubleshoot and maintain systems
   - ◆Operate and maintain systems

13. Assess the Impact of Products and Systems
   - ◆Collect information and judge its quality
   - ◆Synthesize data to draw conclusions
   - ◆Employ assessment techniques
   - ◆Design forecasting techniques

14. Medical Technologies
   - ◆Telemedicine
   - ◆Genetic therapeutics
   - ◆Medical technologies for prevention and rehabilitation
   - ◆Biochemistry

15. Agricultural and Related Biotechnologies
   - ◆Agricultural products and systems
   - ◆Biotechnology
   - ◆Engineering design and management of ecosystems
   - ◆Conservation

16. Energy and Power Technologies
   - ◆Law of conservation of energy
   - ◆Energy sources
   - ◆Second Law of Thermodynamics
   - ◆Power systems are a source, a process and a load
   - ◆Renewable and non-renewable forms of energy

Established design principles are used to evaluate existing designs, to collect data and to guide the design process.

17. Information and Communications Technologies
    - Information and communication systems
    - Communication through symbols
    - Communication systems and sub-systems
    - Parts of information and communication systems
    - Many ways of communicating
    - The purpose of information and communication technology

18. Transportation Technologies
    - Intermodalism
    - Transportation services and methods
    - Positive and negative impacts of transportation systems
    - Relationship of transportation and other technologies
    - Transportation processes and efficiency

19. Manufacturing Technologies
    - Servicing and obsolescence
    - Durable or non-durable goods
    - Manufacturing systems
    - Interchangeability of parts
    - Chemical technologies
    - Marketing products
    - Materials

20. Construction Technologies
    - Requirements
    - Prefabricated materials
    - Infrastructure
    - Maintenance, alterations and renovation
    - Construction processes and procedures

Creative thinking and economic and cultural influences shape technological development.

Program Standards

All schools need to provide students with broad-based technological education. The administration and educators must provide a well-planned articulated curriculum that is based on K-12 standards for technological literacy. The program must include an active Technology Student Association (TSA). The technological studies program must be documented curriculum that is accountable to its constituents and is taught by qualified teachers in an environment friendly to all students.

Assessment

Assessment for Technology Education should be consistent with the "*Standards for Technological Literacy."* Students will demonstrate the ability to use, manage, assess and understand technology. The assessment of students learning should be formative, summative or evaluative and should be matched to the purpose. The assessment tools will be

applied in a systematic way and will be derived from accepted assessment principles. Assessment takes place in many forms, from daily records of students' work, interviews, quizzes and tests, portfolios of activities in the laboratory-classroom, to standardized tests administered by the school system. The ultimate goal in any educational assessment process is to be able to determine how well each student is attaining technological literacy in grades K-12.

Professional Development

Professional development is an important component for the successful implementation of a Technology Education Program. Teachers of Technology must initially develop a knowledge base in the preservice program that supports the basic concepts of the human modification of the natural environment. Continuous professional development is a key component from the preservice level throughout the teaching career. Acquiring effective teaching practices that enhance and extend the learning of technology will maximize students learning and create positive student attitudes toward the study of technology. The practicing technology education teacher will gain understanding and skills in the design, implementation, maintenance and evaluation of a dynamic curriculum. Professional development will also provide opportunities for technology teachers to remain current in research on teaching and learning, contemporary delivery strategies, effective teaching approaches and assessment. Comprehensive and sustained professional growth will improve the learning experiences for students and adults associated with the study of technology.

Technology comprises the entire system of people and organizations, knowledge, processes and devices that go into creating and operating technological artifacts, as well as the artifacts themselves.

Coverage of Standards for Technological Literacy in Technology Education Courses

	Grades K-5 (Elementary School) Introduction and Exploration			Grades 6-8 (Middle School) Exploration and Engagement				Grades 9-12 (High School) Application			
	Elementary K-2 (6-36 weeks)	Elementary 3-5 (6-36 weeks)		Exploring Technology (6-36 weeks)	Innovation and Engineering Design (18-36 weeks)	Technological Systems (18-36 weeks)		Foundations of Technology (18-36 weeks)	Technology Assessment (18-36 weeks)	Innovations in Technology (18-36 weeks)	Design for Engineering (18-36 weeks)
Standard 1	**	*		**	***	*		****	****	**	**
Standard 2	**	*		**	***	***		****	****	**	**
Standard 3	**	*		**	*	***		****	****	****	**
Standard 4	*	**		**	*	***		****	****	****	**
Standard 5	**	***		**	***	*		****	**	****	**
Standard 6	**	*		**	***	*		****	****	****	**
Standard 7	**	*		**	*	***		****	**	***	**
Standard 8	*	**		**	*	***		****	****	***	*****
Standard 9	*	**		**	***	*		****	****	***	*****
Standard 10	*	**		**	***	*		****	**	***	*****
Standard 11	**	**		**	***	*		****	****	***	****
Standard 12	***	***		**	***	***		****	****	*****	****
Standard 13	*	*		**	*	***		****	****	****	****
Standard 14	*	*		**	*	***		****	**	****	****
Standard 15	*	*		**	*	***		****	**	****	****
Standard 16	*	*		**	***	*		****	**	****	****
Standard 17	**	**		**	***	*		****	**	****	****
Standard 18	*	*		**	***	*		****	**	****	****
Standard 19	*	*		**	*	***		****	**	****	****
Standard 20	*	*		**	***	*		****	**	****	****

Key:

Level of Standards Implementation

* Familiar

**

*** Know

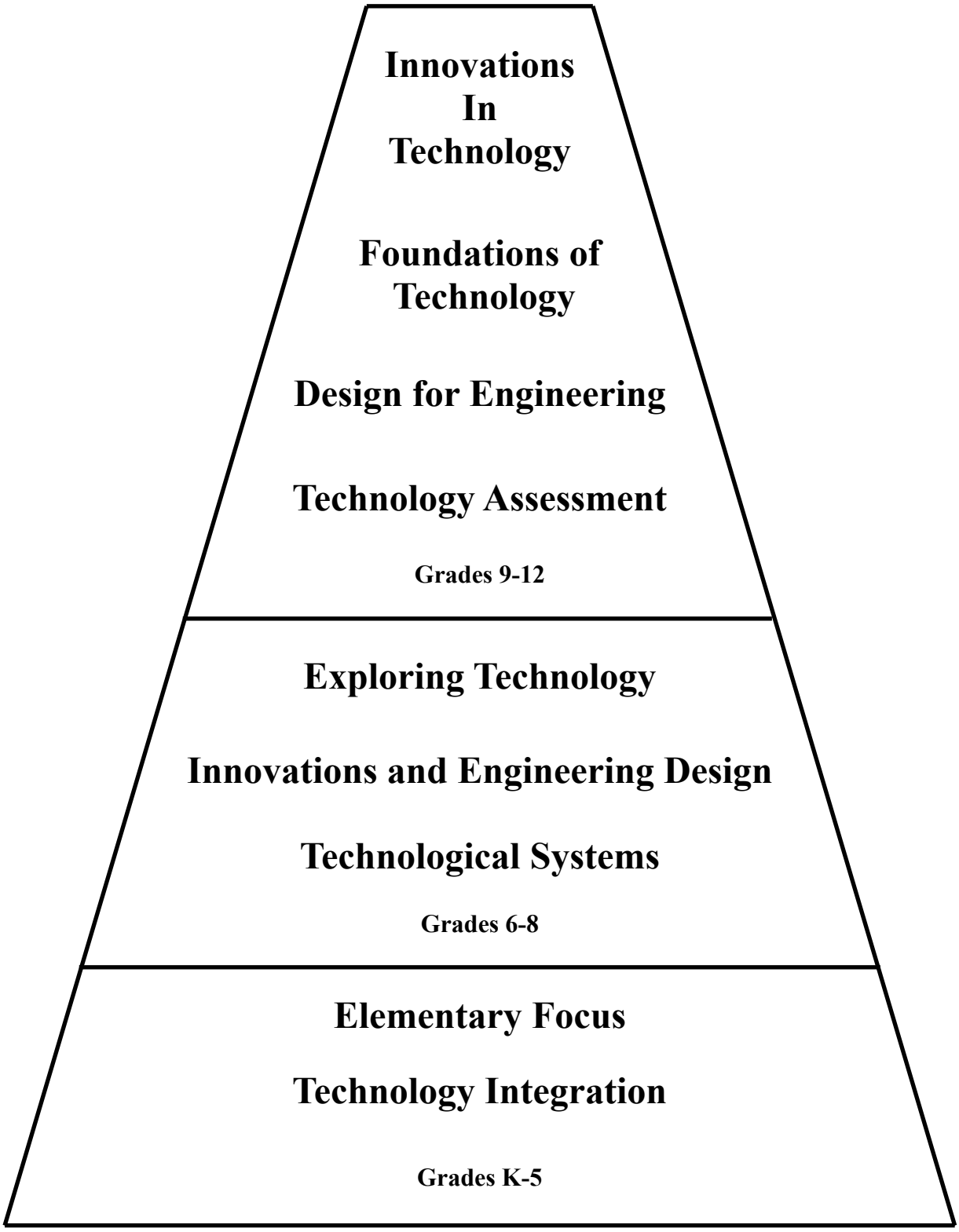
****

***** Enduring Understanding

The table above shows the courses and grade levels at which the standards should be addressed. The level of implementation is indicated by the number of * in each column. These levels of implementation will help direct which standards should be the focus during your curriculum development process. The following terms explain what students should know and understand at the various levels of implementation.

Familiar – students are introduced to the basic concepts and fundamental content elements in a broad perspective
Know – students are able to apply content knowledge to a process
Enduring Understanding – students have an in depth knowledge of content and are able to synthesize information and apply it to technological problems and real life situations

North Dakota Technology Education



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The North Dakota Technology Education Curricular Framework is designed to assist in planning, developing and implementing Technology Education programs. The materials presented will aid local school systems as they engage in curriculum development. It provides a philosophical foundation and a broad outline from which educators may construct a comprehensive K-12 Technology Education program.

"There is nothing inevitable about the changes influenced by technology - they are the result of human decisions." (p.18)

"In a world permeated by technology, an individual can function more effectively if he or she is familiar with and has a basic understanding of technology." (p.25)

"Technological literacy is fundamentally about providing citizens with the tools to participate fully and confidently in the world around them." (p.12)

Committee on Technological Literacy (2002) "Technically Speaking: Why all Americans need to know more about technology"

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